Geometry Notes

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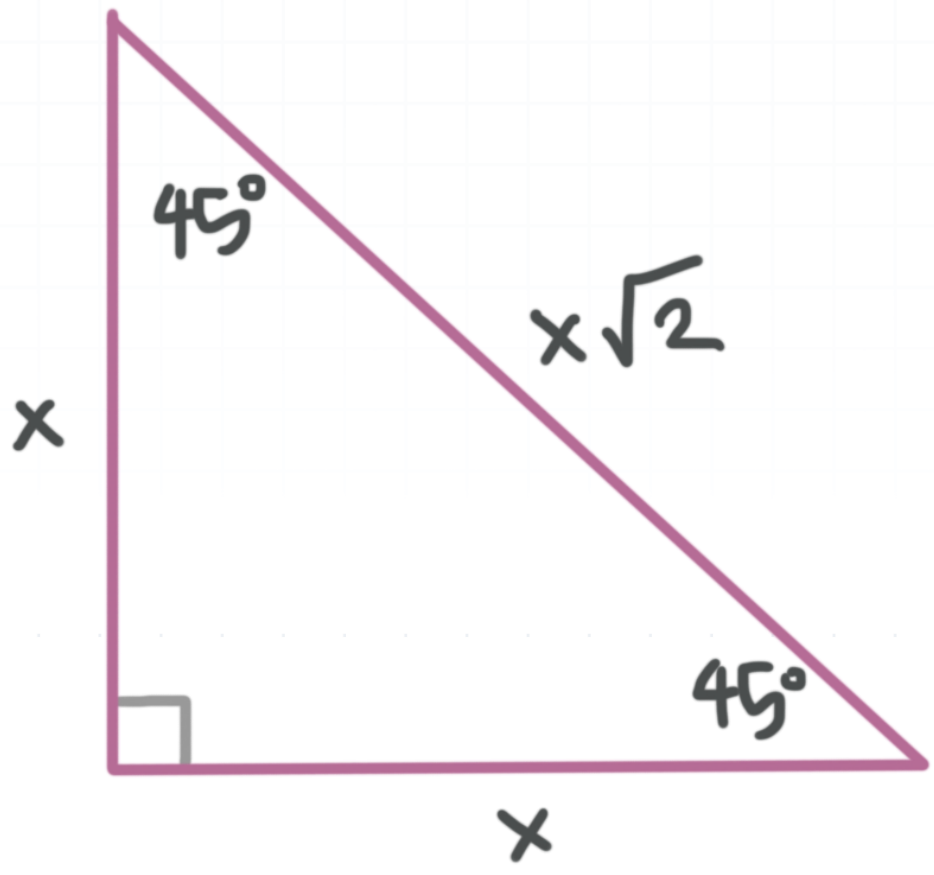
MATH

45-45-90 triangles

A $45-45-90$ triangle is a special kind of right triangle, because it's isosceles with two congruent sides and two congruent angles. Since it's a right triangle, the congruent sides are called the legs of the triangle and the hypotenuse is the side across from the right angle.

In this diagram, the legs are labeled x, and the hypotenuse is labeled $x\sqrt{2}$, because this is always the ratio of the side lengths of a $45-45-90$ triangle.



You can use the relationships in this $45-45-90$ triangle to solve all $45-45-90$ triangles.

Let's start by working through an example.

Example

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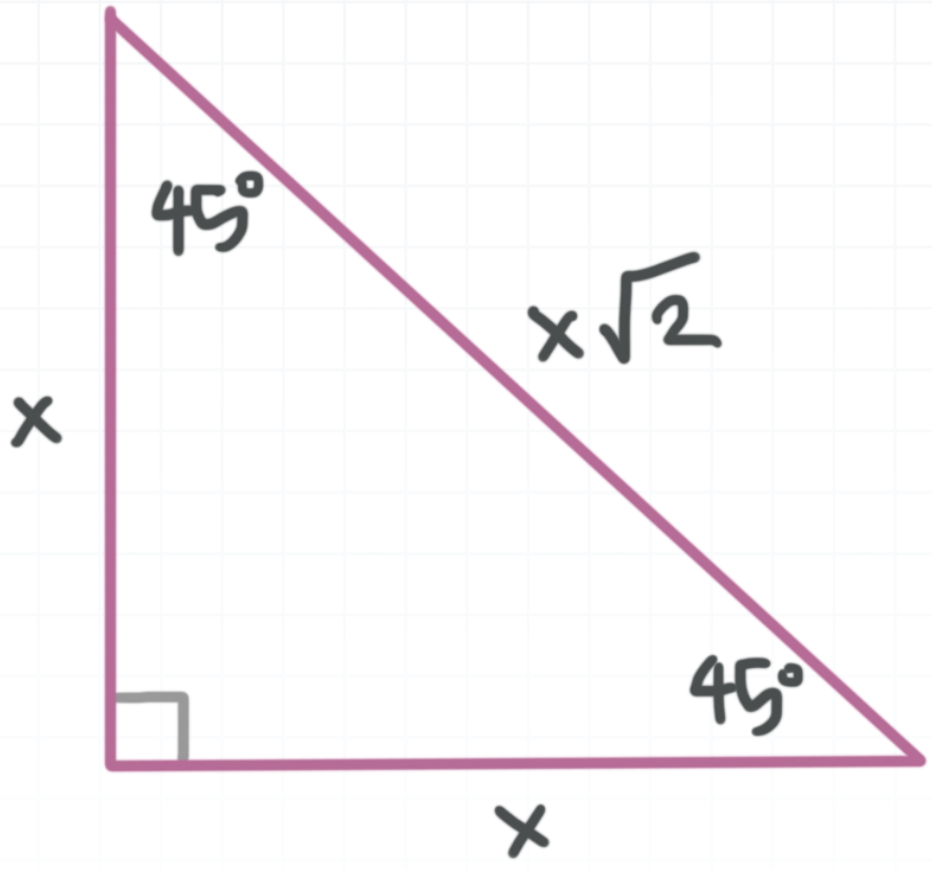
If $x = 12$, what is the length of the hypotenuse?



The hypotenuse is related to x by $x\sqrt{2}$. We know $x = 12$, so the hypotenuse is $x\sqrt{2}$, or $12\sqrt{2}$.

Let's do another example.

Example

What is the measure of side AC and side CB?

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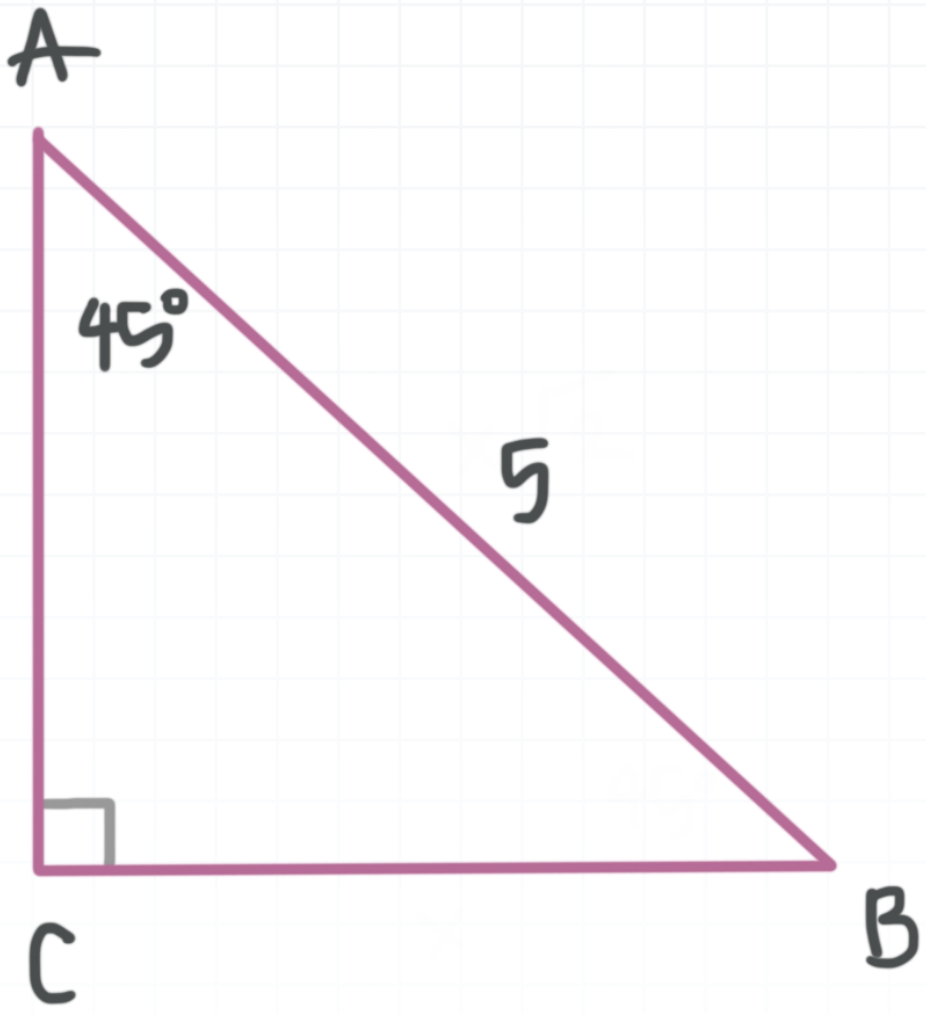

The hypotenuse AB corresponds to $x\sqrt{2}$. We need to set up an equation to solve for x so that we can use it to find the lengths of sides AC and CB.

$$5 = x\sqrt{2}$$

$$x = \frac{5}{\sqrt{2}} = \frac{5}{\sqrt{2}} \cdot \frac{\sqrt{2}}{\sqrt{2}} = \frac{5\sqrt{2}}{2}$$

This means sides AC and CB both have length $5\sqrt{2}/2$. We could also have used the Pythagorean theorem.

$$a^2 + b^2 = c^2$$

$$x^2 + x^2 = 5^2$$

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$$2x^2 = 25$$

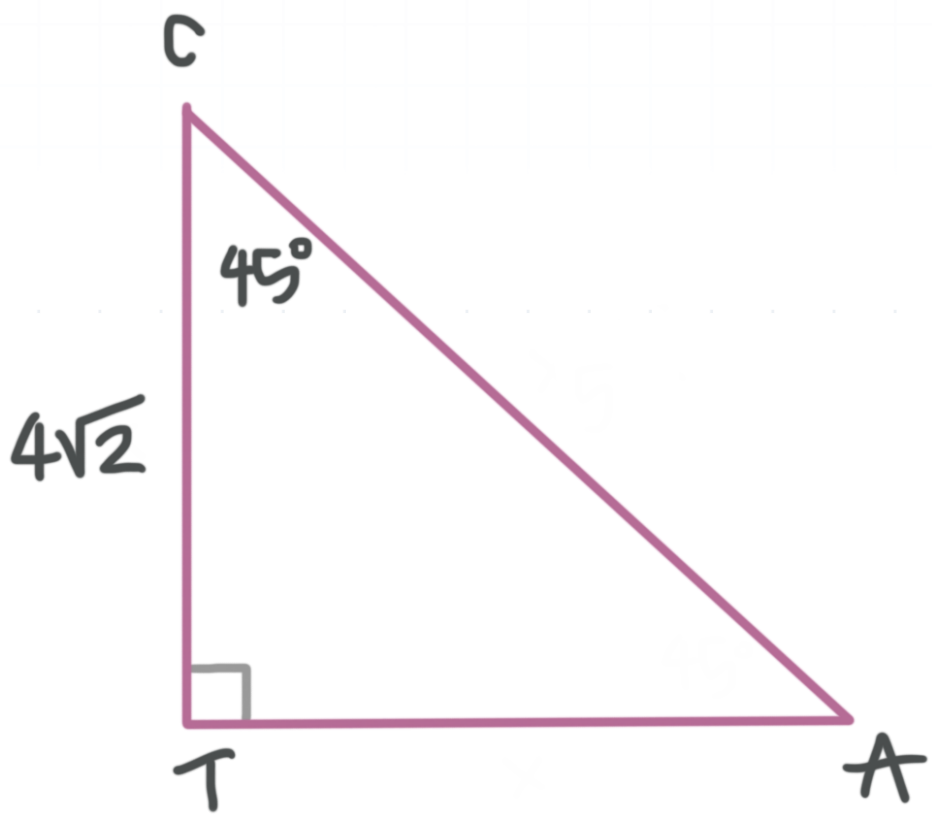
$$x^2 = \frac{25}{2}$$

$$x = \frac{5}{\sqrt{2}} = \frac{5}{\sqrt{2}} \cdot \frac{\sqrt{2}}{\sqrt{2}} = \frac{5\sqrt{2}}{2}$$

Let's try another example.

Example

What is the length of side CA?



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The pattern for the sides of a $45-45-90$ triangle is x, x, and $x\sqrt{2}$, where x is the length of each leg. In this case, $x = 4\sqrt{2}$. The hypotenuse is $x\sqrt{2}$, so the length of the hypotenuse CA is

$$4\sqrt{2}\sqrt{2}$$

$$4(2)$$

8 units

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